

INCH-POUND

MIL-I-24768
25 February 1992

SUPERSEDING
(See section 6)

MILITARY SPECIFICATION
INSULATION, PLASTICS, LAMINATED, THERMOSETTING;
GENERAL SPECIFICATION FOR

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers thermosetting plastic laminated insulation materials for mechanical and electrical military applications.

1.2 Classification. The form and type of insulation shall be as specified in the applicable specification sheet (see 3.1 and 6.2.1).

1.2.1 Types. The types of insulation grouped according to the base material used, shall be as follows:

a. Cotton Fabric Base, Phenolic-Resin Binder

- | | | |
|-----|---|--|
| FBE | – | Cotton Fabric Base, Phenolic-Resin, Electrical Grade |
| FBG | – | Cotton Fabric Base, Phenolic-Resin, General Purpose |
| FBI | – | Cotton Fabric Base, Phenolic-Resin, Machining Applications |
| FBM | – | Cotton Fabric Base, Phenolic-Resin, Mechanical Grade |

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using a self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

FSC 5970

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b. Glass Fabric, Base, Epoxy-Resin Binder

- GEE – Glass Fabric Base, Epoxy-Resin, Electrical Grade
- GEB – Glass Fabric Base, Epoxy-Resin, High Temperature Electrical Grade
- GEE-F – Glass Fabric Base, Epoxy-Resin, Flame Resistant, Electrical Grade
- GEB-F – Glass Fabric Base, Epoxy-Resin, High Temperature, Flame Resistant, Electrical Grade

c. Glass Fabric Base, Melamine-Resin Binder

- GME – Glass Fabric Base, Melamine-Resin, Electrical Grade
- GMG – Glass Fabric Base, Melamine-Resin, General Purpose

d. Glass Mat Base, Polyester-Resin Binder

- GPO N-1 – Glass Mat Base, Polyester-Resin, Mechanical Grade
- GPO N-2 – Glass Mat Base, Polyester-Resin, Low Flammability and Self-extinguishing Properties, General Purpose
- GPO N-3 – Glass Mat Base, Polyester-Resin, Track Resistance, Low Flammability and Self-extinguishing Properties, General Purpose
- GPO N-1P – Glass Mat Base, Polyester-Resin, Mechanical Grade, Punching Characteristics
- GPO N-2P – Glass Mat Base, Polyester-Resin, Low Flammability, Self-extinguishing Properties, Punching Characteristics
- GPO N-3P – Glass Mat Base, Polyester-Resin, Track Resistance, Low Flammability, Self-extinguishing Properties, Punching Characteristics

e. Glass Fabric Base, Silicone-Resin Binder

- GSG – Glass Fabric Base, Silicone-Resin, General Purpose

f. Glass Fabric Base, Polytetrafluoroethylene-Resin Binder

- GTE – Glass Fabric Base, Polytetrafluoroethylene-Resin, Electrical Grade

g. Glass Fabric Base, Phenolic-Resin Binder

- GPG – Glass Fabric Base, Phenolic-Resin, General Purpose

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h. Nylon Fabric Base, Phenolic-Resin Binder

NPG – Nylon Fabric Base, Phenolic-Resin, General Purpose

i. Paper Base, Phenolic-Resin Binder

PBE – Paper Base, Phenolic-Resin, Electrical Grade

PBG – Paper Base, Phenolic-Resin, General Purpose

PBM – Paper Base, Phenolic-Resin, Mechanical Grade

PBM-P – Paper Base, Phenolic-Resin, Hot Punching Stock, Mechanical Grade

PBM-PC – Paper Base, Phenolic-Resin, Cold Punching and Shearing Stock, Mechanical Grade

PBG-P – Paper Base, Phenolic-Resin, Hot Punching Stock, General Purpose

PBE-P – Paper Base, Phenolic-Resin, Hot Punching Stock, Electrical Grade

PBE-PC – Paper Base, Phenolic-Resin, Cold Punching Stock, Electrical Grade

PBM-PF – Paper Base, Phenolic-Resin, Hot Punching Stock, Flame Resistant, Mechanical Grade

PBE-PCF – Paper Base, Phenolic-Resin, Cold Punching Stock, Flame Resistant, Electrical Grade

j. Paper Base, Epoxy-Resin Binder

PEE – Paper Base, Epoxy-Resin, Flame Resistant, Electrical Grade

k. Continuous Filament Glass Cloth, Epoxy-Resin Binder

CEM-1 – Glass Cloth Base, Epoxy-Resin, Cellulose Core

CEM-3 – Glass Cloth Base, Epoxy-Resin, Nonwoven Core

1.2.2 Form of insulation. The insulation forms shall be as follows:

Form R – Rods

Form S – Sheets

Form TRR – Tubes, rolled, round

Form TMR – Tubes, molded, round.

1.2.3 Sizes. The sizes of insulation shall be as specified in the individual specification sheets (see 3.1).

2. APPLICABLE DOCUMENTS

2.1 Government documents.

2.1.1 Specifications and standards. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents shall be those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS), and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS

FEDERAL

PPP-F-320	Fiberboard, Corrugated and Solid, Sheet Stock (Container Grade) and Cut Shapes
UU-P-268	Paper, Kraft, Wrapping

MILITARY

MIL-P-116	Preservation, Methods of
MIL-L-19140	Lumber and Plywood, Fire Retardant Treated

STANDARDS

FEDERAL

FED-STD-406	Plastics: Methods of Testing
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MILITARY

MIL-STD-104	Limits for Electrical Insulation Color
MIL-STD-105	Sampling Procedures and Tables for Inspection by Attributes
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-1186	Cushioning, Anchoring, Bracing, Blocking and Waterproofing with Appropriate Test Methods
MIL-STD-2073-1	DOD Material Procedures for Development and Application of Packaging Requirements

(See supplement 1 for list of associated specifications.)

(Unless otherwise indicated, copies of federal and military specifications, standards, and handbooks are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.2 Other publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted shall be those listed in the issue of the DODISS specified in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS shall be the issue of the nongovernment documents which is current on the date of the solicitation (see 6.2).

NATIONAL ELECTRICAL MANUFACTURERS ASSOCIATION (NEMA)

LI-1 Industrial Laminated Thermosetting Products

(Application for copies should be addressed to the National Electrical Manufacturers Association, 2101 L Street, NW, Washington, DC 20037.)

AMERICAN SOCIETY FOR TESTING AND MATERIAL (ASTM)

D 150	Standard Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials; (DOD adopted)
D 229	Standard Method of Testing Rigid Sheet and Plate Materials Used for Electrical Insulation; (DOD adopted)
D 256	Standard Test Methods for Impact Resistance of Plastics and Electrical Insulating Materials; (DOD adopted)
D 257	Standard Test Methods for D-C Resistance or Conductance of Insulating Materials; (DOD adopted)
D 348	Standard Methods of Testing Rigid Tubes Used for Electrical Insulation
D 349	Standard Laminated Round Rods Used for Electrical Insulation
D 374	Standard Test Methods for Thickness of Solid Electrical Insulation
D 495	Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation; (DOD adopted)
D 570	Standard Test Method for Water Absorption of Plastics; (DOD adopted)
D 618	Standard Methods of Conditioning Plastics and Electrical Insulating Materials for Testing; (DOD adopted)
D 668	Standard Methods of Measuring Dimensions of Rigid Rods and Tubes Used for Electrical Insulation
D 792	Standard Test Methods for Specific Gravity, Relative Density and Density of Plastics by Displacement; (DOD adopted)
D 877	Standard Test Method for Dielectric Breakdown Voltage of Insulating Liquids Using Disk Electrodes; (DOD adopted)

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D 3951	Standard Practice for Commercial Practice; (DOD adopted)
D 2303	Standard Test Method for Liquid-Contaminant, Inclined-Plane Tracking and Erosion of Insulating Materials
D 2304	Standard Method for Thermal Evaluation of Rigid Electrical Insulating Materials
G 21	Standard Recommended Practice for Determining Resistance of Synthetic Polymeric Materials to Fungi; (DOD adopted)

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

UNIFORM CLASSIFICATION COMMITTEE AGENT

Uniform Freight Classification Ratings, Rules and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Nongovernment standards and other publications are normally available from the organizations which prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for associated detail specifications, specification sheets or MS standards), the test of this specification shall take precedence. Nothing in this document, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Specification sheets. The individual item requirements shall be as specified herein and in accordance with the applicable specification sheets. In the event of any conflict between requirements of this specification and the specification sheets, the latter shall govern.

3.2 First article. When specified (see 6.2) a sample shall be subjected to first article inspection (see 4.5 and 6.5).

3.3 Material. The material shall be as specified herein and in accordance with the applicable specification sheets (see 3.1).

3.3.1 Sheets. Sheets shall consist of a base or filler, properly impregnated with a thermosetting-resin compound or binder, and processed to conform to the specification sheets.

3.3.2 Rods. Rods shall be composed of laminations of impregnated sheet material which have been molded in cylindrical molds under high pressure and temperature and then ground to size.

3.3.3 Tubes. Tubes shall be formed by rolling impregnated sheet material upon mandrels between heat pressure rolls and then either oven-baking for rolled tubes or pressing the material in a heated mold for molded tubes until the curing or setting of the resin into the infusible form is completed.

3.3.4 Recovered materials. Unless otherwise specified herein, all materials incorporated in the products covered by this specification shall be new and may be fabricated using material produced from recovered materials to the maximum extent practicable without jeopardizing the intended use. The term "recovered materials" means materials which have been collected or recovered from solid waste and reprocessed to become a source of raw materials, as opposed to virgin raw materials. None of the above shall be interpreted to mean that the use of used products is allowed under this specification unless otherwise specified.

3.4 Physical Characteristics. The insulation material shall be of the construction and dimensions, and have the property values specified herein and in the applicable specification sheet (see 3.1).

3.4.1 Machinability. The laminated material shall be such that it can be drilled, tapped, sawed, and machined in all directions without cracking, splitting or otherwise impairing the material for general use. The nature of laminated materials necessitates special precautions when drilling or tapping parallel to laminations.

3.4.1.1 Fine machining applications. The laminated materials FBI and FBE shall be suitable for fine machining applications requiring close tolerances.

3.4.2 Color. Unless otherwise specified (see 3.1 and 6.2), laminated materials designated GSG, FBE, FBG, FBI, FBM, and NPG shall be natural in color, which may vary from white to light brown. Natural color is the color produced by a combination of a natural undyed base or filler and the resin used. The brown color due to heat treatment of glass fibers may be streaked or mottled, provided it can be shown that a nonuniform color does not impair the performance characteristics of the material. The color for the other materials shall conform to MIL-STD-104 if rated above 2000 volts, and natural color if used below 2000 volts.

3.4.3 Uniformity. All material of any lot shall be uniform in texture, finish, and specified properties.

3.4.4 Surface finish.

3.4.4.1 Laminated sheets. Unless otherwise specified (see 6.2), the surface finish of laminated sheets shall be semigloss as produced by the laminating process.

3.4.4.2 Laminated tubes and rods. Unless otherwise specified (see 6.2), tubes shall be furnished in the following finishes.

3.4.4.2.1 Ground. Ground finish is applied by a fine grinding wheel or belt and is free from any pronounced scratches.

3.4.4.2.2 Buffed. Buffed finish is somewhat more glossy than the ground finish and is obtained by buffing the tube or rod immediately after grinding, using a small amount of shellac or other polishing compound on the buffer.

3.4.4.2.3 Varnished. Varnished finish is obtained by coating the rod or tube with varnish and then air-drying or baking. Due to the operations involved with a varnished finish, the physical and electrical properties may change greatly.

3.4.5 Surface defects.

3.4.5.1 Laminated sheets. Sheets shall be free from internal and external blisters, wrinkles, or cracks and other small defects such as scratches, dents, or heat marks. If the insulation material contains a glass fabric, differential coloration of various wrap or filler threads of the glass fabric or the filament of the nonwoven parallel alignment fibers may cause streaks.

3.4.5.2 Laminated tubes and rods. Laminated tubes shall be free from blisters, pronounced mandrel scores, loose layers, resin pockets, voids, and heat marks. Rolled tubes shall be free from wrinkles. Molded tubes shall be free from seam cracks. Rods shall be free from blisters, mold seam cracks, voids, and resin pockets. Tubes with a wall thickness greater than 0.500 inch or rods with a diameter greater than 1.000 inch may show checks or cracks between the laminations on machined or sawed edges. Edges, drilled holes, and machined, milled or ground faces of laminated rods and tubes shall be smooth and shall present a neat appearance.

3.4.6 Warp or twist.

3.4.6.1 Standard 36 by 36 inches laminated sheets. The warp or twist of material as delivered, shall not exceed the values of table I. Percentage of warp is given in terms of lateral dimensions (length and width) of the material and percentage of twist is given in terms of dimensions from one corner to the opposite corner.

TABLE I. *Warp or twist.*

Thickness (inches)	Maximum variation (percent)
0.031 to 0.061	5.00
0.062 to 0.124	2.50
0.125 to 0.250	1.00 ¹
0.251 to 0.750	0.50
0.751 to max.	0.25

¹The value for type GSG shall be 1.5 percent.

3.4.6.2 Non-standard sheets. The warp or twist of laminated sheets other than 36 inches shall be determined using the following formula:

$$\frac{D_X}{D_{36}} = \frac{L_X^2}{(36)^2}$$

where:

- D_X = Permissible deviation from straight edge in inches for the given length
 D_{36} = Permissible deviation in inches for 36 inch lengths
 L_X = The given length in inches.

3.4.6.3 Laminated tube and rods. The warp material furnished in the tube or rod form, as delivered, shall not exceed the values specified in table II. Percentage of warp is specified in terms of a 36-inch length of material. Measurement of warpage shall be as specified in ASTM D 668.

TABLE II. *Warp.*

Outside diameter (inch)	Maximum variation (percent)
0.125 to 0.250	2.00
0.251 to 0.750	1.00 ¹
0.751 to max.	0.50

¹The value for type GSG shall be 1.5 percent.

3.4.7 Length and width.

3.4.7.1 Laminated sheets. Unless otherwise specified (see 3.1), the contractor's standard sizes between 18 and 50 inches in width and 36 and 96 inches in length will be acceptable. The length and width of sheets may vary \pm one inch from the contractor's standard size. Nonuniform standard sheet dimensions caused by cutting specimens for tests required by this specification shall not be cause for rejection, unless particular dimensions are specified. When particular sheet dimensions are specified (see 6.2), the permissible variation from specified length or width shall be as shown in table III.

3.4.7.2 Laminated tubes and rods. Unless otherwise specified (see 6.2), tubes and rods shall be furnished in contractor's standard lengths, with a tolerance of \pm one inch.

3.4.7.2.1 Tubes. When specified (see 6.2), the tubes shall be furnished cut to length, circular-sawed, within the tolerances shown in table IV. Dimensions shall be measured as specified in ASTM D 668.

3.4.7.2.2 Rods. When specified (see 6.2), rods shall be furnished cut to length within the tolerances shown in table V. Dimensions shall be measured as specified in ASTM D 668.

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TABLE III. *Permissible variations in length or width.*

Thickness (inches)	Permissible variation (\pm inch)		
	6 inches and under	6.001 to 23.999 inches	24 inches and over
Up to 0.250	0.010	0.015	0.031
0.251 to 0.500	0.012	0.017	0.031
0.501 to 1.000	0.015	0.020	0.031
1.001 to 1.500	0.018	0.030	0.062
1.501 to 3.500	0.022	0.040	0.062

TABLE IV. *Tolerances of cut round tubes.*

Tube length (inches)	Tolerances (\pm inch)			
	Outside diameter (inches)			
	Min. to 2.000	2.001 to 4.000	4.001 to 8.000	8.001 to max.
Min. to 3.000	0.010	0.010	0.030	—
3.001 to 6.000	0.010	0.015	0.030	—
6.001 to 12.000	0.015	0.020	0.030	—
12.001 to 48.000	0.031	0.031	0.047	—
48.001 to 72.000	0.062	0.078	0.094	0.188
72.001 to 96.000	0.094	0.094	0.125	0.250

TABLE V. *Tolerances of cut rods.*

Rod length (inches)	Tolerances (\pm inch)	
	Outside diameter	
	0.125 to 1.999 inches	2 to 4 inches
Min. to 3.000	0.010	0.010
3.001 to 6.000	0.010	0.015
6.001 to 12.000	0.015	0.020
12.001 to 48.000	0.030	0.031

3.4.8 Thickness and diameter.

3.4.8.1 Laminated sheets. Sheets shall be furnished in the nominal thickness as specified (see 3.1 and 6.2). At least 90 percent of the area of the sheet shall be within the variations specified and at no point shall the thickness, as measured, vary from the nominal thickness by a value greater than 125 percent of tolerance specified. Dimensions shall be measured as specified in ASTM D 374.

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3.4.8.2 Laminated rods and tubes. The diameter of rods and the inside diameter, outside diameter and wall thickness of round tubes shall be as specified (see 3.1 and 6.2). Tolerances for tubes shall be as specified in table VI and VII. Tolerances for rods shall be as specified in table VIII. Dimensions shall be measured as specified in ASTM D 668.

TABLE VI. *Diametral tolerances for round tubes.*

Type	Nominal diameter (inches)	Inside diameter (\pm inch)		Outside diameter (\pm inch)
		Steel mandrel ¹	Built-up mandrel ²	
Rolled and molded	0.125 to 0.749	0.003	—	0.005
	0.750 to 1.999	0.004	—	0.005
	2.000 to 4.000	0.008	—	0.008
Rolled only	4.001 to 12.000	0.010	—	0.025
	12.001 to 18.000	0.030	0.060	0.030 ³
	18.001 to 24.000	0.040	0.075	0.035 ³
	24.001 to 48.000	0.060	0.090	0.040 ³

¹Type GMG tubes are made on steel mandrels only.

²In the absence of a mandrel of the precise size required, tubes of that size can sometimes be made on a built-up mandrel. In such cases, this is accomplished by winding a phenolic laminate rolled tube on the next smaller size steel mandrel and then curling and grinding the tube to the desired size.

³Tubes from 12.001 to 48.000 inches outside diameter shall be turned to the prescribed permissible variations in outside diameter.

TABLE VII. *Steps in inside and outside diameters.*

Type ¹	Inside diameter (inches) ²	Outside diameter (inches)	Increments of sizes of tubes (inch)
Rolled tubes	0.125 — 1.000	—	0.031
	1.001 — 3.000	—	0.062
	3.001 — 6.000	—	0.125
	6.001 — 8.000	—	0.250
	8.001 — 25.000	—	0.500
Molded tubes	0.125 — 1.000	0.188 — 1.000	0.031
	1.001 — 3.000	1.001 — 3.000	0.062
	3.001 — 3.875	3.001 — 4.000	0.125

¹No standards have been developed for type GMG tubes with an inside diameter greater than 8.000 inches.

²In the range of inside diameters from 8.001 to 25.000, standard steps of 0.500 inch are indicated. In some cases, these inside diameters can only be achieved by the use of built-up mandrels.

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TABLE VIII. *Diametral tolerances for rods.*

Diameter (inches)	Tolerances (\pm inch)
0.125 to 1.999	0.005
2.000 to 4.000	0.008

3.4.9 Marking.

3.4.9.1 Laminated sheets. Each full sized sheet shall be legibly marked on the right-hand corner on each side with the contractor's name or trademark and the insulation type as specified in 1.2.1. Such markings shall not be obliterated by normal processing nor shall they affect the physical or electrical properties of the base material. The contractor's name or trademark shall be in accordance with MIL-STD-130.

3.4.9.2 Laminated tubes and rods. Each bundle of tubes or rods shall be identified with the contractor's name or trademark and the insulation type as specified in 1.2.1. The contractor's name or trademark shall be in accordance with MIL-STD-130.

3.5 Property values.

3.5.1 Dielectric breakdown. The laminated material shall exceed the minimum dielectric breakdown voltage as specified in the applicable specification sheets (see 3.1 and 4.6.4).

3.5.2 Dielectric strength. The laminated material shall exceed the minimum dielectric strength voltage as specified in the applicable specification sheets (see 3.1 and 4.6.5).

3.5.3 Dielectric constant (permittivity). The maximum dielectric constant of the laminated material shall not exceed the value as specified in the applicable specification sheets (see 3.1 and 4.6.6).

3.5.4 Dissipation factor. The laminated material shall not exceed the maximum dissipation factor as specified in the applicable specification sheets (see 3.1 and 4.6.6).

3.5.5 Volume resistivity. The laminated material shall exceed the minimum volume resistivity as specified in the applicable specification sheets (see 3.1 and 4.6.7).

3.5.6 Surface resistance. The laminated material shall exceed the minimum surface resistance as specified in the applicable specification sheets (see 3.1 and 4.6.8).

3.5.7 Arc resistance (dry tracking). The laminated material shall exceed the minimum time limit required for arc resistance as specified in the applicable specification sheets (see 3.1 and 4.6.9).

3.5.8 Tracking resistance (wet tracking). The minimum time to track to the one-inch mark shall be not less than the value specified in the applicable specification sheets (see 3.1 and 4.6.10).

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3.5.9 Impact strength. The laminated material shall exceed the minimum impact strength as specified in the applicable specification sheets (see 3.1 and 4.6.11).

3.5.10 Flexural strength. The laminated material shall exceed the minimum flexural strength as specified in the applicable specification sheets (see 3.1 and 4.6.12).

3.5.11 Thermal endurance. The flexural strength shall be not less than the value specified in the applicable specification sheets (see 3.1 and 4.6.13).

3.5.12 Compressive strength. The average minimum compressive strength of the laminated material shall be not less than the value specified in the applicable specification sheets (see 3.1 and 4.6.14).

3.5.13 Bonding strength. The laminated material shall exceed the minimum bonding strength as specified (see 3.1 and 4.6.15).

3.5.14 Specific gravity. The minimum specific gravity of the laminated material shall be not less than the value specified in the applicable specification sheets (see 3.1 and 4.6.16).

3.5.15 Water absorption. The laminated material shall not exceed the maximum water absorption as specified in the applicable specification sheets (see 3.1 and 4.6.17).

3.5.16 Silicone content. The silicone content shall not exceed the value specified in the applicable specification sheets (see 3.1 and 4.6.18).

3.5.17 Flammability.

3.5.17.1 Burning rate. The burning rate of the laminated sheets shall be either class 0 or class 1 as specified in the applicable specification sheets (see 3.1 and 4.6.19.1).

3.5.17.2 Flame resistance. The average ignition time shall be not less and the average burning time shall be not greater than that specified in the applicable specification sheets (see 3.1 and 4.6.19.2).

3.5.18 Fungus resistance. The laminated material shall resist the growth of fungi and shall have a visual rating of "0" (see 4.6.20).

3.6 Workmanship. Laminated rods, tubes, and sheet materials shall be manufactured and processed in a careful and workmanlike manner and shall be free from defects which may affect the appearance of serviceability. The resin shall be completely bonded to the base material and shall show no exposed reinforcement.

4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract or purchase order, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract or purchase order, the contractor may use his own or any facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to assure supplies and services conform to prescribed requirements.

4.1.1 Responsibility for compliance. All items must meet all requirements of sections 3 and 5. The inspection set forth in this specification shall become a part of the contractor's overall inspection system or quality program. The absence of any inspection requirements in the specification shall not relieve the contractor of the responsibility of assuring that all products or supplies submitted to the Government for acceptance comply with all requirements of the contract. Sampling in quality conformance does not authorize submission of known defective material, either indicated or actual, nor does it commit the Government to acceptance of defective material (see 6.3).

4.2 Classification of inspections. The inspections specified herein are classified as follows:

- a. First article inspection (see 4.5)
- b. Quality conformance inspection (see 4.6).

4.3 Inspection conditioning.

4.3.1 Conditions. Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in NEMA LI-1 and ASTM D 618.

4.3.2 Specimen conditioning.

4.3.2.1 Type of conditioning. The following letters shall be used to indicate the type of conditioning required:

- a. Condition A – As received; no special conditioning
- b. Condition C – Humidity conditioning
- c. Condition D – Immersion conditioning in distilled water
- d. Condition D₁ – Immersion conditioning in distilled water following temperature conditioning (E-1/105)
- e. Condition E – Temperature conditioning.

4.3.2.2 Designation. Conditioning procedures shall be designated in accordance with the following:

- a. A capital letter indicating the general condition of the specimen to be tested. Condition may be as received, or conditioned to humidity, immersion or temperature (see 4.3.2.1).
- b. A number indicating the duration of conditioning hours.
- c. A number indicating the conditioning temperature in degrees Celsius (°C)
- d. A number indicating the relative humidity whenever the relative humidity is controlled.

4.3.2.2.1 Thermal testing. If the specimen is to be tested at a temperature other than 23 °C, then a colon followed by the letter T and the applicable test temperature shall follow the conditioning designation.

4.3.2.2.2 Examples. The numbers shall be separated from the capital letter by a dash and from each other by a slash mark. Examples of conditioning procedure designations are as follows:

- a. Condition C-96/35/90 – Means humidity conditioning for 96 hours at 35 °C and 90 percent humidity
- b. Condition E-1/150:T-50 – Means temperature conditioning for 1 hour at 150 °C and tested at 50 °C
- c. Condition D₁-24/23 – Means immersion conditioning for 24 hours in distilled water at 23 °C after E-1/105; temperature conditioning for 1 hour at 105 °C.

4.3.2.3 Time tolerances. After oven conditioning the test specimen shall be cooled to room temperature (23 °C) in a desiccator. After immersion conditioning, the test specimen shall be cooled to room temperature in distilled water as specified in table IX.

4.3.2.4 Temperature tolerances. The tolerance in the nominal conditioning temperature of 23, 35, 50, 105, and 150 °C shall be ± 2 °C.

4.3.2.5 Humidity tolerances. The tolerance in the nominal relative humidity of 90 percent humidity shall be ± 2 percent.

TABLE IX. *Time tolerances for conditioning.*

Conditioning		Cooling		Comments
Condition	Time tolerance	Time	Time tolerance	
E-48/50	-0 hours +2 hours	16 hours or more	-0 hours	Cool the specimen in a desiccator. Start the test within 1/2 hour after removing the specimen from the desiccator.
D-48/50 D-24/23 D-366/50	-0 hours +1/2 hours	1 hour	-hours +hours	Cool the specimen by immersing in a sufficient quantity of distilled water to reduce its temperature to 23 °C within one hour. Remove the specimens individually as they are needed and wipe the surface water off with a cloth. Start the test within one minute after removing the specimen from the water.
E-1/105	-0 minutes +6 minutes	2 hours or more	-0 hours	See water absorption test 4.6.17
E-1/150	-0 minutes +6 minutes	—	—	The test for flexural strength shall be made in the oven immediately after the conditioning period.
D ₁ -24/23	-0 hours +2 hours	—	—	See water absorption test 4.6.17
C-96/35/90	-0 hours +2 hours	—	—	Tests after humidity conditioning shall be made on specimens in the humidity chamber.

4.4 First article inspection. First article inspection shall consist of the examinations and tests shown in tables X, XI and XII as specified in the applicable specification sheets (see 3.1). First article inspection shall be performed at a facility acceptable to the Government on laminated material produced with equipment and procedures normally used.

4.4.1 Sampling. Laminated sheets of indicated type of rating offered for delivery on the contract or order shall be subjected to the first article inspection as specified in table X. Each specimen shall be 36 inches, or greater in length and width. Laminated tubes or rods, at least 24 inches in length, shall be subjected to the first article inspection as specified in tables XI and XII respectively.

4.4.2 Rejections. If a specimen does not meet property values under the first article inspection, that specimen and those of the same type and lot shall be rejected.

4.4.3 Construction changes. A first article inspection shall be performed after any change which affects property values.

TABLE X. *First article inspection, sheets.*

Requirement	Test method	Number of determinations for each condition per thickness		
		0.062 inch	0.125 inch	0.500 inch
Examination	4.6.1	10	10	10
Dimensions				
Warp or twist	4.6.2.1.1	10	10	10
Length and width	4.6.2.1.2	10	10	10
Thickness	4.6.2.1.3	10	10	10
Machinability	4.6.3	—	—	Avg of 2
Dielectric breakdown				
Short time	4.6.4	1	1	1
Step-by-step		Avg of 4	Avg of 4	Avg of 4
Dielectric strength				
Short time	4.6.5	1	—	—
Step-by-step		Avg of 4		
Dielectric constant	4.6.6	—	Avg of 4	—
Dissipation factor	4.6.6	—	Avg of 4	—
Volume resistivity	4.6.7	—	Avg of 4	—
Surface resistance	4.6.8	—	Avg of 4	—
Arc resistance	4.6.9	Avg of 4	Avg of 4	Avg of 4
Tracking resistance	4.6.10	Avg of 4	Avg of 4	Avg of 4
Impact strength				
Lengthwise	4.6.11	—	Avg of 4	Avg of 4
Crosswise			Avg of 4	Avg of 4
Flexural strength				
Lengthwise	4.6.12	—	Avg of 4	Avg of 4
Crosswise			Avg of 4	Avg of 4
Thermal endurance				
Flexural strength				
Lengthwise	4.6.13	—	Avg of 4	—
Crosswise			Avg of 4	
Bonding strength	4.6.15	—	—	Avg of 4
Water absorption	4.6.17	Avg of 4	Avg of 4	Avg of 4
Silicone content	4.6.18	1	1	1
Flammability	4.6.19	—	—	Avg of 5
Fungus resistance	4.6.20	—	3	—

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TABLE XI. *First article inspection, round tubes.*

Requirement	Test method	Number of determinations for each condition per thickness		
		0.062 inch	0.125 inch	0.500 inch
Examination	4.6.1	10	10	10
Dimensions				
Warp		10	10	10
Length	4.6.2.2	10	10	10
Inside diameter		10	10	10
Outside diameter		10	10	10
Machinability	4.6.3	Avg of 2	Avg of 2	Avg of 2
Dielectric breakdown				
Short time	4.6.4	1	1	1
Step-by-step		Avg of 4	Avg of 4	Avg of 4
Dielectric strength				
Short time	4.6.5.2	Avg of 5	Avg of 5	Avg of 5
Compressive strength	4.6.14.17	Avg of 5	Avg of 5	Avg of 5
Specific gravity	4.6.16	Avg of 2	Avg of 2	Avg of 2
Water absorption	4.6.17	Avg of 4	Avg of 4	Avg of 4

TABLE XII. *First article inspection, rods.*

Requirement	Test method	Number of determinations for each condition per outside diameter		
		0.062 inch	0.125 inch	0.500 inch
Examination	4.6.1	10	10	10
Dimensions				
Warp		10	10	10
Length	4.6.2.2	10	10	10
Outside diameter		10	10	10
Machinability	4.6.3	Avg of 2	Avg of 2	Avg of 2
Flexural strength	4.6.12	Avg of 4	Avg of 4	Avg of 4
Compressive strength	4.6.14.2	Avg of 5	Avg of 5	Avg of 5
Specific gravity	4.6.16	Avg of 2	Avg of 2	Avg of 2
Water absorption	4.6.17	Avg of 4	Avg of 4	Avg of 4

4.5 Quality conformance inspection. Quality conformance inspection shall consist of the inspections and tests shown in tables XIII, XIV, and XV. Quality conformance inspections shall be performed on every lot of laminated material acquired under this specification.

TABLE XIII. *Quality conformance inspection, sheets.*

Requirement	Test method	Condition	Numbers of determinations for each specimen tested
<i>Group A</i> Examination	4.6.1	A	1
<i>Group B</i> Dimensions			
Warp or twist	4.6.2.1.1	A	1
Length and width	4.6.2.1.2		1
Thickness	4.6.2.1.3		1
<i>Group C</i> Machinability	4.6.3	A	1
Dielectric breakdown	4.6.4	A	
Short time			1
Step-by-step			Avg of 4
Flexural strength	4.6.12	A	
Lengthwise			Avg of 4
Crosswise			Avg of 4
Bonding strength	4.6.15	A	Avg of 4

TABLE XIV. *Quality conformance inspection, tubes.*

Requirement	Test method	Condition	Numbers of determinations for each specimen tested
<i>Group A</i> Examination	4.6.1	A	1
<i>Group B</i> Dimensions			
Warp			1
Length	4.6.2.2	A	1
Inside diameter			1
Outside diameter			1
<i>Group C</i> Machinability	4.6.3	A	1
Dielectric strength	4.6.5.2	A	Avg of 5
Short time			
Compressive strength	4.6.14.1	A	Avg of 5
Specific gravity	4.6.16	A	Avg of 2

TABLE XV. *Quality conformance inspection, rods.*

Requirement	Test method	Condition	Numbers of determinations for each specimen tested
<i>Group A</i> Examination	4.6.1	A	1
<i>Group B</i> Dimensions			
Warp			1
Length	4.6.2.2	A	1
Outside diameter			1
<i>Group C</i> Machinability	4.6.3	A	1
Flexural strength	4.6.12	A	Avg of 5
Compressive strength	4.6.14	A	Avg of 5
Specific gravity	4.6.16	A	Avg of 2

4.5.1 Lot. For the purpose of quality conformance inspection and test sampling, a lot is defined as all the laminated material produced in one facility, using the same materials, of the same type rating, style, production processes and being offered for delivery at one time.

4.5.2 Sampling for quality conformance inspection. As a minimum, the contractor shall randomly select a sample quantity from each lot of completed laminated material in accordance with table XVI and inspect them in accordance with 4.6. If one or more defects are found in any sample, the entire lot shall be rejected. The contractor has the option of screening 100 percent of the lot for the defective characteristic(s) or providing a new lot which shall be inspected in accordance with sampling plan contained herein. The contractor shall maintain for a period of three years after contract completion, records of inspections, tests, and any resulting rejections.

4.5.3 Defects. The classification of defects for group A inspection shall be as specified in table XVII.

TABLE XVI. *Sampling plan for quality conformance inspections and tests.*

Lot size	Sample size		
	Sampling Plan Group A	Sampling plan Group B	Sampling plan Group C
2 to 8	All	5	3
9 to 15	8	5	3
16 to 25	8	5	3
26 to 50	8	5	5
51 to 90	8	7	6
91 to 150	12	11	7
151 to 280	19	13	10
281 to 500	21	16	11
501 to 1,200	27	19	15
1,201 to 3,200	35	23	18
3,201 to 10,000	38	29	22

TABLE XVII. *Classification of defects.*

Categories	Defects
Critical	None defined
Major:	
101	Not uniform in texture or finish
102	Blisters, wrinkles, cracks, splits or holes
103	Excessive number of scratches, dents, heat marks, voids or resin pockets
104	Presence of dirt, foreign material, or embedded particles
105	Reinforcement exposed, not uniformly spaced. Incomplete bond.
106	Color not as specified
107	Finish not as specified
108	Length and width of standard sizes varies by more than \pm one inch
109	Length and width of cut sizes varies by more than tolerances specified
110	Thickness varies by more than the tolerances specified
111	Markings not as specified
112	Diameter varies by more than the tolerances specified
113	Wall thickness varies by more than the tolerances specified
114	Not homogeneous

4.5.4 Rejections. Each specimen that fails any of the group tests shall be removed from the lot. If an inspection lot is rejected, the contractor may screen out the defective specimens if possible and resubmit for inspection. Resubmitted lots shall be kept separate from new lots and shall be clearly identified as resubmitted lots. Resubmitted lots shall be inspected using the tightened inspection procedure of MIL-STD-105.

4.6 Methods of inspection.

4.6.1 Examination. The laminated material shall be inspected to verify that materials, construction, and markings are in accordance with this specification. This examination and the categories of defects shall be as specified in table XVII.

4.6.2 Dimensions.

4.6.2.1 Laminated sheets.

4.6.2.1.1 Warp and twist. The warp and twist test shall conform to FED-STD-406 (see 3.4.6). The warp and twist test shall be made on a full size sheet, a portion of which may be used for destructive tests.

4.6.2.1.2 Length and width. The length and width of the laminated material shall be measured as specified in 3.5.7. The length and width shall be within the tolerances specified for the thickness of material being measured.

4.6.2.1.3 Thickness. Thickness shall be measured in accordance with ASTM D 374 at 10 points distributed over the entire full sheet. On test specimens, the dead weight dial micrometer, method C, shall be used. On sheets with one dimension over 24 inches, method B shall be used. A micrometer fitted to a yoke of size and rigidity to permit accurate measurements in the center of the sheet shall be used (see 3.5.8).

4.6.2.2 Laminated tubes and rods. Dimensions of laminated tubes and rods and the total warpage shall be measured as specified in ASTM D 668 (see 3.5.6, 3.5.7 and 3.5.8).

4.6.3 Machinability. The machinability of the laminated material shall be tested in accordance with the manufacturer's recommended technique and shall meet the requirements of 3.5.1.

4.6.4 Dielectric breakdown. Dielectric breakdown parallel to the laminations shall be tested on laminated sheets using the tapered pin method specified in ASTM D 229 and on certain laminated tubes as specified in ASTM D 348 (see 3.6.1). Sheets shall be 2 inches by 3 inches by the thickness of the sheet. Five samples shall be tested, one sample using the short-time method and four samples using the step-by-step method conditioned as specified in the applicable specification sheet (see 3.1). Laminated tube wall thickness shall be as specified in the applicable specification sheet (see 3.1).

4.6.5 Dielectric strength.

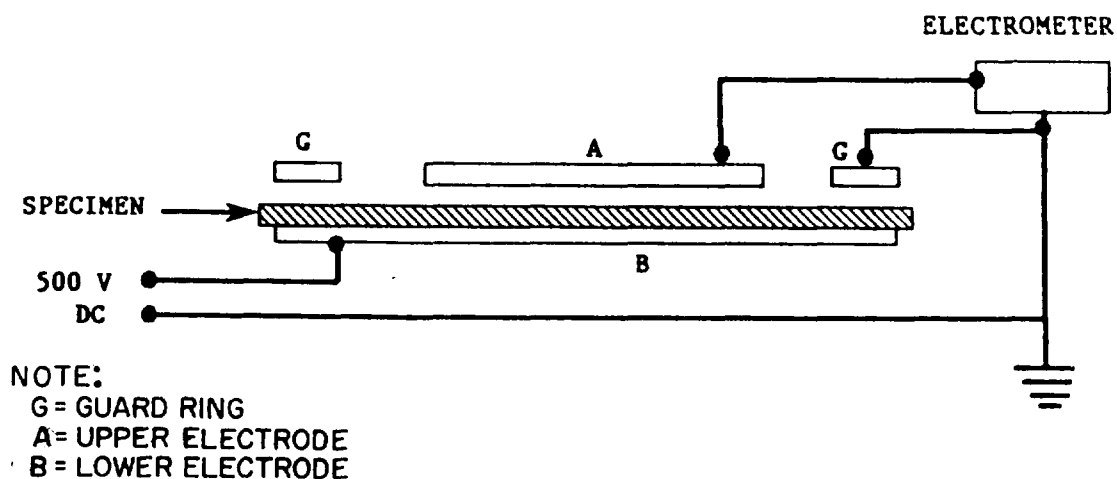
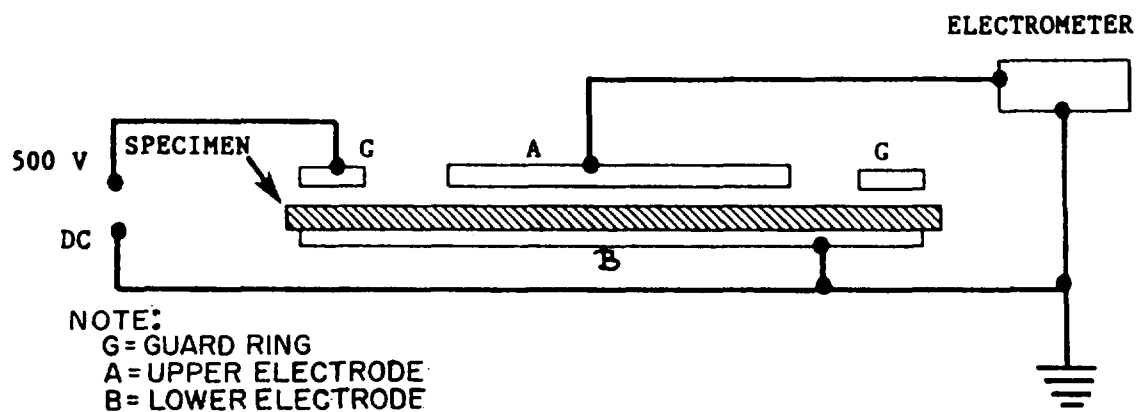
4.6.5.1 Sheets. The dielectric strength test perpendicular to the laminations shall be as specified in ASTM D 229. The test specimens shall be 0.062 inch thick and of length and width to prevent flashover when tested in air. Specimens 12 by 12 inches are suggested. All tests shall be made in air, at 60 hertz (Hz), using electrodes 2 inches in diameter and 1 inch in length with the edges rounded to radius of 0.25 inch (see 3.6.2)

4.6.5.2 Tubes. The dielectric strength test perpendicular to the laminations shall be as specified in ASTM D 348. The test specimen shall be 12 inches long. The tests shall be made by the short-time method with a voltage increase of 500 volts per second (see 3.6.2). Tests shall be made in oil in accordance with ASTM D 877 at a frequency not exceeding 100 Hz.

4.6.6 Dielectric constant and dissipation factor. The test for dielectric constant and dissipation factor shall be conducted as specified in ASTM D 229. The specimens shall be rectangular samples cut from sheets as specified in table XVIII. The electrodes shall cover both sides of the sheet and shall consist of silver paint sprayed or painted on or of metal foil held in place by a thin layer of petrolatum. When the same specimen is used for condition A and for tests after immersion in water, the metal foil electrodes shall be removed and the petrolatum cleaned off with a solvent before immersion. After conditioning, the electrical measurements shall be made as specified in ASTM D 150 using a bridge method, a twin-T impedance-measuring circuit or a resonant circuit substitution method. Unless otherwise specified (see 3.1), measurements shall be made at a frequency of one megahertz (MHz) (see 3.6.3 and 3.6.4)

4.6.7 Volume resistivity. The test for volume resistivity shall be conducted as specified in ASTM D 229. The specimens for test shall be 3.5 by 3.5 inches by thickness. The test electrodes shall be made of conductive silver paint sprayed or brushed on the surfaces of the specimen. The upper electrode shall be in the shape of a circle 2 inches in diameter. A guard ring 0.25 inch wide shall be located concentrically with respect to the upper electrode and spaced 0.25 inch from it. The lower electrode shall be in the shape of a circle 3 inches in diameter. The centers of the upper and lower electrodes shall be centered as accurately as possible so that they are on the same axis. The potentials applied shall conform to figure 1. The volume resistance shall be measured by means of a 500-volt megohm bridge (electrometer) exactly 1 minute after the current is applied. Tests following humidity conditioning shall be made on specimens in the humidity chamber. Calculations for volume resistivity shall be as specified in ASTM D 257 and shall meet the requirements specified in 3.6.5.

4.6.8 Surface resistance. The test for surface resistance shall be made on the same specimens as those used for volume resistivity (see 4.7.7). The test procedure shall be similar to that specified for volume resistivity with the exception of the potentials applied to the lower electrode and the guard ring shall be interchanged conforming to figure 2. The surface resistance shall be measured by means of a 500-volt megohm bridge (electrometer) exactly 1 minute after the current is applied. Tests following the humidity conditioning shall be made on specimens in the humidity chamber (see 3.6.6.).

FIGURE 1. *Volume resistivity test setup.*FIGURE 2. *Surface resistance test setup.*

4.6.9 Arc resistance. The arc resistance test shall be performed in accordance with ASTM D 495 using tungsten rod electrodes (see 3.6.7).

4.6.10 Tracking resistance. Testing for tracking resistance shall be performed in accordance with ASTM D 2303 utilizing the time-to-track method. Liquid contaminants shall be used on specimens at least 0.25 inch in thickness. Specimens less than 0.25 inch in thickness shall be stacked up to at least 0.25 inch thick (see 3.6.8).

4.6.11 Impact strength. Impact strength (see 3.6.9) shall be tested only on laminated sheets and shall be performed in accordance with ASTM D 256, method A.

4.6.12 Flexural strength. Flexural strength shall be tested on laminated sheets and rods (see 3.6.10) and shall be performed in accordance with ASTM D 229 and ASTM D 349, respectively. Specimens shall be heated at the test temperature for 30 ± 5 minutes prior to testing. The size of the sheets and test speed shall be as specified in ASTM D 229. For paper and fabric-base laminated sheets having a nominal thickness over one inch, the specimens shall be machined on both surfaces to a thickness of one inch. For glass and nylon-base laminated sheets having a nominal thickness over 0.500 inch, the specimens shall be machined on both surfaces to a thickness of 0.500 inch. The length of rods and test speed shall be as specified in ASTM D 349.

4.6.13 Thermal endurance. Thermal endurance and temperature classification shall be conducted in accordance with aging oven, thermal exposure, flexural strength, and specimen provisions of ASTM D 2304 (see 3.5.11) at the temperature specified in the applicable specification sheet (see 3.1).

4.6.13.1 End points. The thermal life (end points) shall be conducted in accordance with ASTM D 2304 and shall be not less than 50 percent of the as received flexural strength value.

4.6.13.2 Calculations. The thermal life (end points) of each exposed temperature shall be plotted on graph paper having as ordinates a logarithmic time scale and an abscissa arranged according to the reciprocal of the absolute temperature. If applicable, draw a straight line by the use of regression analysis to represent the life of the material as a function of temperature. The temperature classification index shall be determined by the intersection of the Life-Temperature line with the 25,000 hour ordinate.

4.6.14 Compressive strength. Compressive strength for laminated tubes and rods shall be tested as follows (see 3.5.12).

4.6.14.1 Tubes. The axial compressive strength of laminated tubes shall be determined as specified in ASTM D 348. The length of each specimen shall be one inch.

4.6.14.2 Rods. The axial compressive strength of laminated rods and the length of the test specimens shall be determined as specified in ASTM D 349.

4.6.15 Bonding strength. The test for bonding strength shall be conducted in accordance with ASTM D 229 and applies only to laminated sheets (see 3.5.13).

4.6.16 Specific gravity. The specific gravity shall be determined by ASTM D 792 for laminated tubes and rods (see 3.5.14).

4.6.17 Water absorption. The water absorption test shall be conducted in accordance with ASTM D 570 (see 3.5.15).

4.6.18 Silicone content. Volatile siloxanes shall be as determined by the gas chromatographic method (see 3.5.16).

4.6.18.1 Chromatographic method for the detection of siloxane vapors.

4.6.18.1.1 Sample size. The specimen size shall be 1 by 10 inches by the thickness.

4.6.18.1.2 Conditioning procedure. The sample shall be placed in a 250 milliliter (ml). Erlenmeyer flask, fitted with a ground glass stopper containing a 2 millimeter (mm) diameter capillary. This assembly shall then be maintained in an air oven for 168 hours at 185 °C.

4.6.18.1.3 Sampling and detection of vapors. A 10 ml sample of vapor in the Erlenmeyer flask shall be obtained by inserting a syringe needle through the capillary in the glass stopper. A convenient sampling device consists of a 10 ml Luer-lock syringe fitted with a 4 inch 20 or 22 gauge hypodermic needle. Next the sample shall be injected into a gas chromatograph and its chromatogram recorded.

4.6.18.1.4 Chromatographic column. Columns shall be as specified in table XIX.

4.6.18.1.5 Calibration. Chromatographic system shall be calibrated using cyclic hexamethyl-trisiloxane (D_3 trimer) in 1,2-dichlorobenzene or other suitable solvent.

TABLE XIX. *Chromatographic columns.*

Description	Packed column	Capillary column
Stationary phase	Silicone oil-DC 550 20 percent	Silicone oil-DC-550
Support	C-22 Firebrick 42/60 mesh	Non-applicable
Length	6 feet	150 feet, min.
Diameter	0.125 inch	Standard
Oven temperature	70 °C	70 °C
Detector	Hydrogen flame ionization	Hydrogen flame ionization

4.6.18.1.6 Qualitative detection. If any of the peaks on the chromatograms from the insulating materials show a retention time identical to that of the standard cyclic hexamethyltrisiloxane (D_3 trimer) degradative siloxane vapors are considered to be present; unless it can be shown by modified chromatographic techniques that this peak is not due to D_3 trimer. If no D_3 trimer is detected, a 10 ml sample of vapor enriched with a small amount of D_3 trimer vapor shall be introduced into the column under identical conditions. Elution of the D_3 trimer at the appropriate retention time shall be considered proof of proper column functioning.

4.6.19 Flammability. Testing for flammability shall consist of two tests, flame resistance and burning rate as specified in ASTM D 229 (see 3.6.17).

4.6.19.1 Burning rate. Testing for burning rate of laminated sheets shall be as specified in ASTM D 229.

4.6.19.2 Flame resistance. Testing for flame resistance of laminated sheets shall be as specified in ASTM D 229.

4.6.20 Fungus resistance. Specimens shall be tested as specified in ASTM G 21 (see 3.6.18).

4.8 Inspection of packaging. Sample packs, and the inspection of the preservation, packing, and marking for shipment, stowage and storage shall be in accordance with the requirements of section 5 and the documents specified therein.

5. PACKAGING.

(The packaging requirements specified herein apply only for direct Government acquisition.)

5.1 General requirement for Navy acquisitions.

5.1.1 Navy fire-retardant requirements.

- a. *Lumber and plywood.* Unless otherwise specified (see 6.2.1), all lumber and plywood including laminated veneer material used in shipping container construction members, blocking, bracing, and reinforcing shall be fire-retardant treated material conforming to MIL-L-19140 as follows:

Levels A and B Type II – weather resistant
Category I – general use

Level C Type I – non-weather resistant
Category I – general use.

- b. *Fiberboard.* Unless otherwise specified (see 6.2.1), fiberboard used in the construction of class-domestic non-weather resistant fiberboard and cleated fiberboard boxes including interior packaging forms shall meet the flamespread and the specific optic density requirements of PPP-F-320 amendments thereto.
- c. *Wrapping paper.* Unless otherwise specified (see 6.2.1), kraft wrapping paper used for interleaving or wrapping (see 5.2.1) shall conform to UU-P-268 type II grade optional.

5.2 Preservation. Preservation shall be level A, C, or commercial as specified (see 6.2.1).

5.2.1 Level A. The laminated material shall be preserved in accordance with method III of MIL-P-116. Laminated sheets shall be wrapped individually or interleaved with kraft wrapping paper to protect sheets from abrasion, Kraft paper conforming to UU-P-268 shall be used except for Navy acquisitions. Kraft paper shall be as specified in 5.1.1.c. Laminated rods and tubes shall be preserved individually in bundles, or in containers as required. Containers shall conform to table I, appendix F or MIL-STD-2073-1 and shall be of the weather resistant type or class. Container selection shall be at the option of the contractor.

5.2.2 Level C. The laminated material shall be preserved as specified for level A except that containers may be of the domestic non-weather resistant type or class.

5.2.3 Commercial. The laminated material shall be preserved in accordance with the ASTM D 3951.

5.3 Packaging. Packing shall be level A, B, C, or commercial as specified (see 6.2.1).

5.3.1. General requirements for levels A, B, and C. Containers selected (see 5.3.2) shall be of minimum weight and cube consistent with the protection required, of uniform size, and contain identical quantities.

5.3.2 Levels A, B, and C containers. Insulating material preserved as specified (see 5.2) shall be packed in exterior shipping containers in accordance with table VII of MIL-STD-2073-1, Appendix C for the level of packing specified (see 5.3) and herein. Unless otherwise specified (see 6.2.1), container selection including container options shall be at the contractor's option.

5.3.2.1 Waterproofing. Unless otherwise specified (see 6.2.1), level A and when specified (see 6.2.1) level B shipping containers shall be provided with caseliners, linings, wraps or shrouds in accordance with the waterproofing requirements of MIL-STD-1186.

5.3.2.2. Closure and gross weight.

5.3.2.2.1 Closure. Container closure, reinforcing, or banding shall be in accordance with the applicable container specification or appendix thereto except that weather-resistant fiberboard boxes shall be closed in accordance with method V and reinforced with non-metallic or tape banding and domestic or fire retardant fiberboard boxes shall be closed in accordance with method I using pressure sensitive tape.

5.3.2.2.2 Weight. Wood, plywood, and cleated type containers exceeding 200 pounds gross weight shall be modified by the addition of skids in accordance with MIL-STD-2073-1, Appendix F or the applicable container specification or appendix thereto.

5.3.3 Commercial. Insulating material preserved as specified (see 5.2) shall be packed for shipment in accordance with ASTM D 3951 and herein.

5.3.3.1 Container modification. Shipping containers exceeding 200 pounds gross weight shall be provided with a minimum of two, 3- by 4-inch nominal wood skids laid flat, or a skid- or sill-type base which will support the material and facilitate handling by mechanical handling equipment during shipment, stowage, and storage.

5.4 Palletized unit loads. When specified (see 6.2.1), containers shall be palletized in accordance with MIL-STD-2073-1, Appendix F.

5.5 Marking.

5.5.1 Levels A, B, C, and commercial. In addition to any special marking required (see 6.2.1), interior (unit) packs, shipping containers, and palletized unit loads shall be marked for shipment, stowage, and storage in accordance with MIL-STD-2073-1, Appendix F.

6. NOTES

6.1 Intended use. The laminated insulation covered by this specification is intended for the following applications of electrical usage.

6.1.1 Sheets. Laminated sheets are generally used as terminal boards, spacers, voltage barriers, motor and generator slot wedges and slot fillers, and circuit boards.

6.1.2 Rods. Laminated rods are intended for a variety of applications such as insulating screws, bolts, and small bushings or spacers where electrical stress is not severe.

6.1.3 Rolled tubes. Rolled tubes are intended for application in coil forms, insulating bushings, bearing retainers, and so forth, where excellent concentricity and good physical and electrical characteristics are required.

6.1.4 Molded tubes. Molded tubes are intended for use in coil forms, insulating bushings, bearing retainers, and so forth, where higher density, lower water absorption, and better dimensional stability are required.

6.2 Acquisition requirements. Acquisition documents must specify the following:

- a. Title, number, and date of this specification
- b. Title, number, and date of applicable specification sheet
- c. Issue of DODISS to be cited in the solicitation, and if required, the specific issue of individual documents referenced (see 2.1 and 2.2)
- d. Classification (see 1.2)

- e. Color, if of other than specified (see 3.5.2)
- f. Surface finish (see 3.5.4)
- g. Non-standard length and width (see 3.5.7)
- h. Non-standard thickness and diameter (see 3.5.8)
- i. When fire-retardant treatment or materials are not required (see 5.1.1.a., b., and c.)
- j. Levels of preservation and packing required (see 5.2 and 5.3)
- k. When container selection and contractors options are not applicable (see 5.3.2)
- l. When waterproofing is not required (see 5.3.2.1)
- m. When palletization is required (see 5.4)
- n. Special marking required (see 5.5.1).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied on a contract. The applicable Data Item Description (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirement for a DD Form 1423.

Referenced paragraph	DID number	DID title	Suggested tailoring
4.1.1	DI-E-2121	Certificate of Compliance	—
4.6	DI-T-2072	Reports, tests	—

The above DID's were those cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDDL), must be researched to ensure that only current, cleared DID's are cited in the DD Form 1423.

6.4 First article. When first article inspection is required, the contracting officer should provide specific guidance to offerors whether the item(s) should be a preproduction sample, a first article sample, a first production item, a sample selected from the first production items, a standard production item from the contractor's current inventory (see 3.3), and the number of items to be tested as specified in 4.5. The contracting officer should also include specific instructions in acquisition documents regarding arrangements for examinations, approval of first article test results, and disposition of first articles. Invitations for bids should provide that the Government reserves the right to waive the requirement for samples for first article inspection to those bidders offering a product which has been previously acquired or tested by the Government, and that bidders offering

such products, who wish to rely on such production or test, must furnish evidence with the bid that prior Government approval is presently appropriate for the pending contract. Bidders should not submit alternate bids unless specifically requested to do so in the solicitation.

6.5 Definitions. For the purpose of this specification, the following definitions apply.

6.5.1 Crosswise. Crosswise (CW) is the direction of the laminated sheet known to be weaker in flexure and shall be 90 degrees to the lengthwise direction.

6.5.2 Edgewise. Edgewise is the load applied to the edge of the laminated sheet or plate.

6.5.3 Flatwise. Flatwise is the load applied to the flat side of the laminated sheet or plate.

6.5.4 Lengthwise. Lengthwise (LW) is the direction of the laminated sheet known to be stronger in flexure.

6.6 Cross-reference. A cross-reference for equivalent designation of laminates is specified in table XXIII.

6.7 International interest. Certain provisions of this specification are the subject of international standardization agreement ABC-NAVY-STD-17. When amendment, revision, or cancellation of this specification is proposed which will modify the international agreement concerned, the preparing activity will take appropriate action through international standardization channels including departmental standardization offices to change the agreement or make other appropriate accommodations.

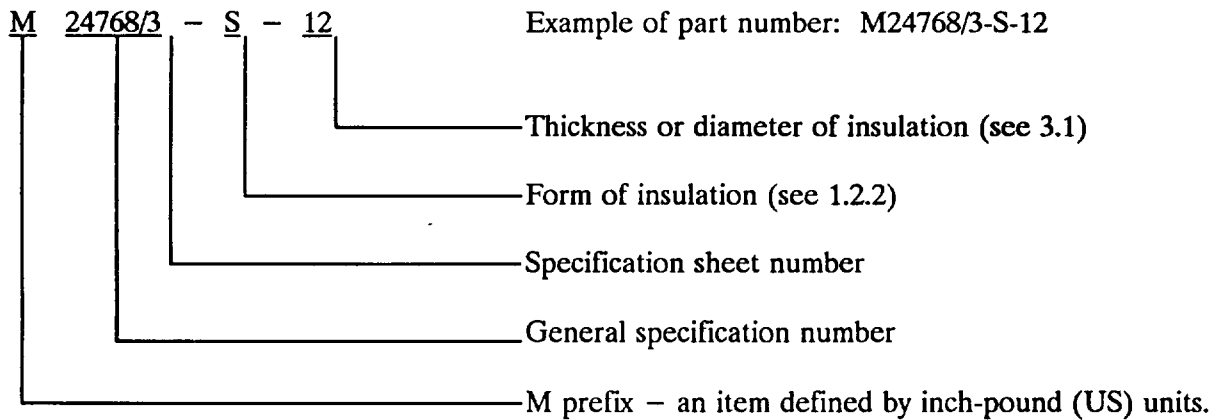
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TABLE XXIII. *Cross-reference guide for laminates.*

Military designation	Industry designation
PBM	X
PBM-P	XP
PBM-PF	FR-1
PBM-PC	XPC
PBG	XX
PBG-P	XXP
PBE	XXX
PBE-P	XXXP
PBE-PC	XXXPC
PBE-PCF	FR-2
PEE	FR-3
FBI	L
FBE	LE
FBG	CE
FBM	C
GPG	G-3
GMG	G-5
GSG	G-7
GME	G-9
GEE	G-10
GEE-F	FR-4
GEB	G-11
GEB-F	FR-5
GTE	GT
NPG	N-1
GPO N-1	GPO-1
GPO N-2	GPO-2
GPO N-3	GPO-3
CEM-1	CEM-1
CEM-3	CEM-3
GPO-N-1P	GPO-1P
GPO-N-2P	GPO-2P
GPO-N-3P	GPO-3P

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6.8 Part numbers. Part numbers under this specification shall be as follows:



6.9 Subject term (Keyword listing).

Bonding strength
Compressive strength
Flexural strength
Thermal endurance
Tracking resistance
Warp

6.10 Supersession data. This specification superseded the following documents:

- a. MIL-P-79C dated 15 June 1961
- b. MIL-P-997D dated 23 November 1966
- c. MIL-P-15035C dated 10 January 1962
- d. MIL-P-15037E dated 2 December 1965
- e. MIL-P-15047C dated 11 June 1971
- f. MIL-P-18177C dated 25 May 1960
- g. MIL-P-19161A dated 21 December 1956
- h. MIL-P-24364 dated 11 July 1969
- i. MIL-P-24364/1 dated 11 July 1969
- j. MIL-P-24364/2 dated 11 July 1969
- k. MIL-P-24364/3 dated 11 July 1969

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Custodians:

Army – ER
Navy – SH
Air Force – 20

Preparing activity:

Navy – SH
(Project 5970-1015)

Review activities:

Army – MI, AR, EA
Navy – EC, OS
Air Force – 85

User activities:

Army – ME
Navy – MC, AS

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
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RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-I-24768	2. DOCUMENT DATE (YYMMDD) 25 February 1992
3. DOCUMENT TITLE Insulation, Plastics, Laminated Thermosetting , General Specification For			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME Technical Point of Contact TPOC: Mr. C. Y. Lu (56223) Please address all correspondence as follows		b. TELEPHONE (Include Area Code) (1) Commercial (703) 602-1323 (2) AUTOVON (AV) 332-1323	
c. ADDRESS (Include Zip Code) Naval Sea Systems Command ATTN: SEA 5523 Washington, DC 20362-5101		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	